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Differences in Methods

- Analytical techniques include additional considerations for non-parametric analysis and for the specific measures in this protocol.
- Reporting plan is based on 2018 IMD data analysis and reporting requirements, adjusted to NGPN sample design.
- Annual reporting may be limited to resource briefs.
- A Park trend report will be published after the fourth sampling visit (i.e. twelve years) and after every third sampling visit thereafter.

Introduction

NGPN will apply standard data analysis processes to characterize reach status, detect spatial or temporal changes, and detect trends in NGPN stream channels. The results of these analyses will be routinely published.

Procedures

Data Analysis

The data collected at each reach are used to determine the status of each stream reach, detect change at each stream reach between sample intervals, and detect trends in the surveyed variables at each stream reach through time. Prior to any analysis, assess the normality of the data. While transforming data to a normal distribution will allow use of parametric tests, it can be difficult to interpret the results of these tests.

Status

Summary statistics of reach-averaged measurements are used to characterize the reach-scale status of the surveyed reaches. These include tables with descriptive statistics listing the minimum, maximum, and mean of stream channel sample metrics, as well as derived habitat measures (e.g. Table 1, Kaufmann et al. 1999). Standardized reach-scale metrics will be used to compare index sites over time and between all the surveyed streams within the network.

See McDonald et al. (2018) for techniques and code for processing cross-section survey data.

Table 1. Example of response metrics calculated from stream channel field measurements.

Objective	Measures or Metrics (Examples)	Units
Determine the status and trend in stream condition via physical habitat.	Volume of Woody Debris per m ² of bankfull channel area	m ³ /m ²
	Streambed Sand & Finer (<2 mm)	%
	Relative Bed Stability (mean bed particle diameter/critical (mobile) diameter at bankfull)	log
	Channel Sinuosity	Unitless
	Incision from terrace to bankfull height	m
	Bankfull Width/Depth Ratio	log
	Low flow/annual mean runoff (inverse index of “droughtiness”)	log
	Bankfull depth/wetted depth (a morphometric index of “flashiness”)	log
	Hydrograph-based metrics for sites with gauges and a long-term record of discharge: Annual total discharge, Annual mean discharge, Highest annual mean, Lowest annual mean, Highest daily mean, Lowest daily mean, Maximum peak flow, Annual seven-day minimum, Annual seven day maximum, April, May, June, July discharge as a percent of the total annual discharge	Various (cm, days)

Change Detection

Change detection tests for significant change (in means or variance) in surveyed variables between two sampling intervals (i.e., from time 1 to time 2 as well as from time 1 to time n). Changes in channel widths, bank heights, and bed sediment between sampling intervals at each reach are evaluated using a paired t-test if the variable is normally distributed, the nonparametric Wilcoxon signed rank test if it is non-normal, or a Fisher exact test (for proportion data). Like the Student’s paired t-test, the Wilcoxon signed rank test determines whether the means of two paired samples are significantly different while not requiring the data to be normally distributed (Crawley 2005).

The F-test (which assumes normality) or Levene’s test (which does not require normality) will be used to compare the variance in thalweg position and depth between sampling intervals. In general, the difference in variance is more informative for habitat quality than the difference in means.

Trends

Trend analysis will use linear mixed models, linear or multiple regression, or the Mann-Kendall test at the reach and transect scale. Due to the repeated measures (transect) design, linear mixed models will be used to detect reach- and transect-scale trends. Regression models will be used to determine if reach-averaged conditions are changing through time.

For non-normal data, trend analysis will use a nonparametric technique such as the Mann-Kendall test. The Mann-Kendall test uses Kendall’s Tau to determine if there is a statistically significant monotonic (upward or downward) trend in the data (Helsel and Hirsch 2002).

Groups of three or more reaches (e.g., all reaches within a park or all reaches within a management unit or habitat type) may be compared using linear mixed models or the regional Kendall test to find similar trends within groups of sites.

If trends are detected in stream data, land cover, climate, hydrology, and other potential influences can be explored and incorporated into mixed effect and regression models as covariates. For example, large-scale conversion of forest to development or flooding may have influenced the reach.

Reporting

NGPN will publish approved data and periodic reports following current NPS IMD reporting requirements (Gallo 2018). Most reports will be published and available to the public in the NPS Natural Resource Publications Series (NRPS; <https://www.nps.gov/im/publication-series.htm>). Some results will also be submitted as articles to Park Science, another NPS journal, or to peer-reviewed, scientific journals. Regardless of the outlet, all reports and publications will adhere to NPS peer-review and publication standards, and will be catalogued in the NPS Data Store (<https://irma.nps.gov/DataStore/>).

NGPN staff may also present data, analytical methods, and results at NGPN Technical Committee meetings, or at regional and national conferences.

Annual Data Summaries

NGPN will publish brief summaries of all approved data within a year of sampling, either as resource briefs for routine updates or through the NRPS Natural Resource Data series for notable or unusual results. These park-by-park data summaries will supplement published data, but will not analyze trends or include significant interpretive discussion. In years that NGPN publishes trend reports, data summaries may be omitted if the trend reports include the same summary data.

Trend Reports

After four sampling cycles (or twelve years), and every three sampling cycles thereafter, NGPN will publish trend reports for each park through the NRPS Natural Resource Report series (per schedule in Gallo (2018)). These reports show the overall status and changes or trends detected in selected parameters, and may make recommendations for assessment thresholds or management actions. These analyses will incorporate other information (e.g., climate data, stream flow) known to influence stream channel characteristics in the Northern Great Plains. Reports will highlight any detected trends to help park managers and other stakeholders understand them.

Interim or out-of-cycle reports may be published if new management practices are implemented or a resource is believed to be changing rapidly.

Other Publications

Routine analyses will be supplemented with periodic, in-depth evaluation of all stream channel characteristics and water quality data in concert with information from other protocols (e.g. NGPN water quality, climate data) or other sources (parks, partners, etc.). These synthesis reports will seek to understand the reasons behind the patterns of status and trends of stream channel attributes, usually within a single park or a group of similar parks (e.g., small parks in the Black Hills).

They will report results of statistical techniques incorporating data from other vital signs monitoring (e.g. water quality/stream flow) to discern relationships among the monitored parameters. When such combined analyses are not possible, trends or patterns discerned from analyzing data from other vital

signs or from other sources will be used to generate hypotheses regarding the reasons for observed changes in stream channel characteristics. For example, land use change and precipitation patterns in the watershed could be incorporated into a statistical model evaluating trends in stream channel characteristics, water quality, stream flow, and climate variables (Wilson et al. 2014, Nelson 2018).

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